# Diagnostic and Therapeutic Guidelines to Abnormal Behavior in Captive Nonhuman Primates

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Abstract: Animal well-being is not only important for any institution or private person holding animals in captivity, but has also attracted increased attention of the public perception in the past decades. It is well acknowledged that behavior constitutes an important indicator of welfare.1 However, common misconceptions of behavior serving as a direct measure of psychological welfare, and erroneous direct inference of suboptimal environmental conditions from abnormal behaviors are largely ignoring the underlying pathophysiological processes in the brain. Mental illness is often prematurely blamed on certain conditions, in the case of captive animals, readily so on their husbandry. Additionally, mental illness, or psychopathology, is often not regarded as a neutral construct but laden with negative valorization.2 Nonhuman primates (NHPs) and people share an array of qualities and neural substrates (including consciousness, self-awareness, social bonding mechanisms, memory, compassion, strategic thinking, and humor), and NHPs' social functioning closely approximates that in people.3 This proximity provokes subjectively biased interpretations of behavior even more than with other taxa. Consequently, unfavorable reactions of visitors to captive animals demonstrating conspicuous behavior quickly result in undue public pressure on the holding institution, calling for immediate action to reduce or eliminate the behavior rather than carefully diagnosing and treating underlying etiologies. Detailed and evidence-based diagnostic approaches, imperative for sustainable treatment success in any disease, are oftentimes not feasible, accepted, or granted in the case of overt abnormal behavior in captive NHPs.

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# Diagnostic and Therapeutic Guidelines to Abnormal Behavior in Captive Nonhuman Primates

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**KEYWORDS**

• Abnormal behavior • Functional analysis • Nonhuman primates
• Operant conditioning • Psychopathology

**KEY POINTS**

- Abnormal behavior must be regarded as a symptom of disturbances in the neuronal structures of the brain (ie, underlying psychopathological disease).
- A diagnostic procedure consisting of behavioral and functional analyses, medical examination, and life history research is necessary for the identification of triggering factors and underlying psychopathology.
- Treatment approaches must be individually tailored combinations of changes in husbandry and social structure, medical treatment of underlying diseases, supporting psychopharmacological treatment, and operant conditioning.
- Genetic selection in regard to mental health and stability may offer a viable strategy for captive breeding programs of nonhuman primates.
- Interdisciplinary cooperation between veterinary clinicians, primatologists, veterinary behavior specialists, and human psychiatrists is recommended.

## INTRODUCTION

Animal well-being is not only important for any institution or private person holding animals in captivity, but has also attracted increased attention of the public perception in the past decades. It is well acknowledged that behavior constitutes an important indicator of welfare.[1] However, common misconceptions of behavior serving as a direct measure of psychological welfare, and erroneous direct inference of suboptimal environmental conditions from abnormal behaviors are largely ignoring the underlying pathophysiological processes in the brain. Mental illness is often prematurely blamed on certain conditions, in the case of captive animals, readily so on their husbandry.

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Additionally, mental illness, or psychopathology, is often not regarded as a neutral construct but laden with negative valorization.[2] Nonhuman primates (NHPs) and people share an array of qualities and neural substrates (including consciousness, self-awareness, social bonding mechanisms, memory, compassion, strategic thinking, and humor), and NHPs' social functioning closely approximates that in people.[3] This proximity provokes subjectively biased interpretations of behavior even more than with other taxa. Consequently, unfavorable reactions of visitors to captive animals demonstrating conspicuous behavior quickly result in undue public pressure on the holding institution, calling for immediate action to reduce or eliminate the behavior rather than carefully diagnosing and treating underlying etiologies. Detailed and evidence-based diagnostic approaches, imperative for sustainable treatment success in any disease, are oftentimes not feasible, accepted, or granted in the case of overt abnormal behavior in captive NHPs.

The present article is intended to promote and increase the understanding of conspicuous behavior as a sign of a malfunctioning and/or diseased organ (ie, brain disorders) and provide guidelines for a structured and comprehensive diagnostic and therapeutic approach for the veterinary clinician faced with a case of abnormal behavior in a captive NHP. The guidelines revolve around a proposed scheme of etiology, pathogenesis, diagnostic and therapeutic approaches. Although any model scheme presents with limitations due to simplification of complex connections, it is useful as a communication tool to illustrate the complex situation and necessary diagnostic and therapeutic procedures to involved stakeholders. The components of the scheme are supported by a large body of literature about psychopathologies in NHP used as model species in human medicine. The full dimensions of the topic of trans-species psychology are beyond the scope of this article; therefore, only certain aspects were selected to substantiate the proposed working scheme. For more detailed background information, the reader is referred to a recent review publication.[4]

## THE PSYCHOPATHOLOGY SCHEME

The proposed scheme for etiology, pathogenesis, diagnostic, and therapeutic approaches for abnormal behavior in captive NHPs is depicted in **Fig. 1** and consists of 3 layers. The inner, red core represents the pathogenesis of psychopathologies leading to abnormal behavior; the middle blue counter-clockwise arrow represents the diagnostic pathway, and the outer, green circle indicates therapeutic approaches.

## PATHOGENESIS OF ABNORMAL BEHAVIOR

The pathogenesis of abnormal behavior is depicted with 3 different entities: predisposition, psychopathological disorders and triggers, and resulting abnormal behavior (see **Fig. 1**). Importantly, the relationships of the factors of these 3 entities are nonspecific, resulting in a diversity of manifestations of psychopathologies, impeding direct deduction from known predispositions, observed behaviors or triggers to underlying psychopathologies.[5]

### *Predisposition*

In analogy to other pathologic processes, such as infectious diseases, predisposition in the context of psychopathology may be regarded as susceptibility, rendering the individual vulnerable or resistant to developing a psychopathological condition.

Despite interspecific differences in neuroanatomy and physiology, mechanisms of psychopathologies are believed to be shared among all vertebrates.[6] Experience of early onset, repeated, sustained, or highly invasive events or trauma lead to

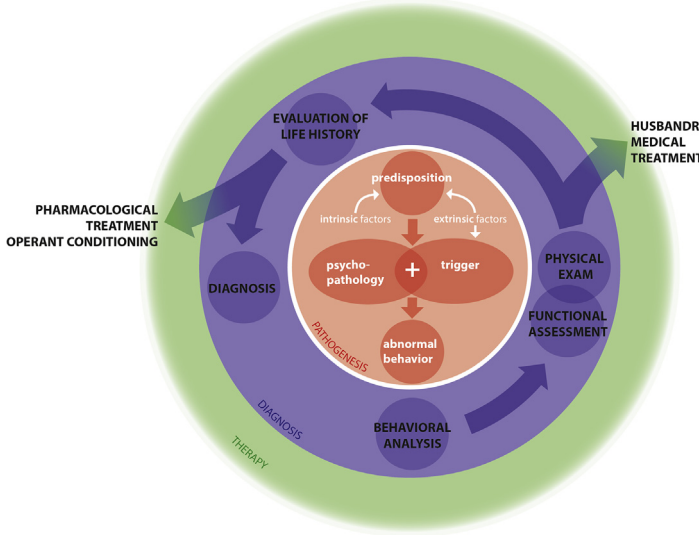


**Fig. 1.** Scheme for etiology, pathogenesis, diagnostic, and therapeutic approaches for abnormal behavior in captive NHP. The inner, red core represents the pathogenesis of psychopathologies leading to abnormal behavior; the middle blue counter-clockwise arrow represents the diagnostic pathway, and the outer, green circle indicates therapeutic approaches.

dysregulation of the neuroendocrine system and its central control, both on the level of the activation and feedback control by neurotransmitters (eg, serotonin, monoamine oxidase MAO-A, dopamine, norepinephrine), as well as the downstream stress hormones axes, (ie, the sympathetic-adrenomedullary system, hypothalamic-pituitary-adrenal axis, and the endogenous opioid system).[4]

Research into human personality psychology indicates a hereditary basis for temperament and personality, and allelic variations have been demonstrated in people as potential contributors to the development of a wide range of psychiatric disorders.[5,7] Similarly, numerous studies claim evidence for inherent expression of personality factors in various animal taxa.[8,9] In rhesus macaques (*Macaca mulatta*), an active personality was positively related to the animals' predisposition for stereotypic behavior.[10] Additionally, sex and age were identified as intrinsic risk factors for the development of behavioral irregularities in several studies.[11–15] The interplay of environment and genes (ie, epigenetics) results in amalgamation of intrinsic and extrinsic factors in the process of shaping predisposition. Genetically fixed, intrinsic factors (eg, sex and endocrinology or neuroanatomy and physiology) and hereditary traits for development of personality and temperament are influenced by the interaction with extrinsic factors, such as environmental conditions or events or diseases, in particular those affecting the brain (eg, infections, neoplasm, neurodegenerative or autoimmune diseases) and pain.[3] Hence, each brain is a unique construct, resulting from the inputs of an individual life history, constantly being shaped by intrinsic and extrinsic factors.

One of the most important predisposing factors for psychopathologies in primatology are social deprivation and in particular early maternal separation. These factors have served as 2 of the most studied and dramatic strategies to experimentally alter early neurobiological development in NHPs in order to use them as models for the understanding of developmentally based vulnerability to adult depression in

people.[3,16,17] In rhesus macaques, early social separations, maternal neglect, and abuse have been demonstrated to result in severe long-term effects in behavioral and cognitive, but also physiologic (eg, differences in thermoregulation, or immune and endocrine responses), neurochemical (eg, differences in neurotransmitter levels and altered responses to neuroactive drugs), and neuroanatomical domains, such as alterations in gross morphology and functional microstructure of the brain.[18]

### *Psychopathology*

Psychopathological processes need to be considered as underlying diseases of abnormal behavior.[19] When applied to nonhuman vertebrates, psychopathology may be considered a controversial term. Bearing the imprint of suppositions, world views, general beliefs and values exemplified in science, history, and general culture of human societies, the attribution of a mind and mental illness to animals has long been considered anthropomorphism and speciescism.[2] The shift to a more clinical and physicalist approach, considering psychopathologies as manifestation of aberrant behavior as consequence of a damaged phenotype, has opened doors to cross-species psychology. In view of the psycho-socio-biological continuity between NHPs and people, dysfunctions of homologous brain structures must be expected to result in psychopathologies in people and NHPs alike.[5,6]

### *Trigger*

Psychopathological disorders and neuroendocrine imbalances remain subclinical until proximal triggers cause the disease to manifest. Triggers are usually acute, extrinsic factors, events, situations, or conditions that can be different from those that first triggered the behavior. Multiple triggers may result in presentation of the same clinical symptoms (ie, abnormal behavior). To complicated the issue, triggers do not only activate clinical symptoms but also continue to shape predisposition for development of psychopathological disorders.

### *Abnormal Behavior*

Abnormal behavior must be regarded as the outward expression or – in analogy to other diseases – symptom of disturbances in the neuronal structures of the brain (ie, underlying psychopathological disease) that is activated by the trigger event or situation.[20] Although at the end of the causative sequence of the pathogenesis, the abnormal behavior, as the component manifesting the underlying disease process, naturally serves as the starting point for the diagnostic procedure (see **Fig. 1**).

## DIAGNOSTIC APPROACH TO ABNORMAL BEHAVIOR

### *Behavior: What Is Normal?*

In a first step, any reported abnormal behavior should be scrutinized regarding the normality of the behavior and reference standards used (**Box 1**). Generally, comparisons with behavioral patterns of conspecifics in the same group, wild counterparts, and - inevitably - people are self-evident, but all pose risks and limitations. Behavior not only serves to cope with environmental circumstances, but is also subject to cultural differences and traditions in groups of great apes and therefore is expected to differ between individuals in different social settings and situations.[31,32] The interdisciplinary approach between human and primate behavior raises conceptual dilemmas termed speciesism and anthropomorphism, concerning differences in behavioral ecology, expressions of emotions, and in gene expression in the brain, not unlike those encountered in comparative human studies across cultures and historic periods.[2] The following general criteria of cross-cultural approaches may therefore serve

**Box 1**
**Abnormal behaviors reported in primates**

- Self-directed behaviors: automutilation/bite-hit-lick, eye-/ear-poking, hair-plucking/self-depilation, thumb-sucking, overgrooming
- Stereotypies
  - Oral: suckling, lip pursing, raspberry vocalization, sticking out tongue
  - Motor: pacing, rocking/bouncing, somersaulting, head tossing, clapping
- Sleep-disturbance
- Eating behaviors: coprophagy, urine drinking, saliva eating, regurgitation, and reingestion (R&R)
- Social behaviors: aggression, withdrawal, indifference, decreased play behavior
- Sexual behaviors: masturbation
- Maternal behaviors: infanticide, abuse, overly protective
- Dissociative and displacement behaviors: inactivity, catatonia, trance-like stares, floating limbs, twirl/rotate torso, vacuum behaviors (chewing, displaying)

*Data from* Refs.[5,6,13,16,18,19,21–30]

as a pragmatic approach to identification of abnormal behavior: persistence and exclusion of any given context, disruption of the flow in an individuals life, and psychological and/or somatic distress (**Table 1**).[2,6]

Stereotypies and regurgitation and reingestion (R&R) qualify as abnormal behaviors because of their repetitive nature without obvious function.[13,22,23,30] Antisocial behaviors interfere with the individual's social life, and automutilative behavior obviously causes physical harm.[19,27] The classification of other behaviors must be individually scrutinized. Coprophagy, for example, was also observed in wild primates and did not seem to interfere with the individual's flow of life; on the contrary, it was identified as a learned, cultural behavior and was associated with positive social behaviors, such as grooming.[23,31] In view of the possibly natural background and lack of detrimental effects on the affected individuals, terms like disagreeably normal or natural and not preferred have been proposed for such behaviors.[31]

Care should be taken when behavioral alterations are classified abnormal relative to an understood social and cultural space; the existence of shame and guilt, prerequisites for ethical standards, are controversially discussed in NHPs, challenging the

**Table 1**
**Application of cross-cultural behavior criteria: selected behaviors tested for normality**

| The Behavior… | …Shows Persistence and Exclusion of any Given Context | …Causes Disruption of the Flow of Individual's Life | …Is Associated with Psychological and/or Somatic Distress |
|---|---|---|---|
| R&R[13,22,23,30,33,34] | Yes | No | Potentially |
| Automutilation[19,27] | Potentially | Potentially | Yes |
| Stereotypies[35] | Yes | Potentially | Potentially |
| Infanticide[5] | No | No | No |
| Aggression[36,37] | Potentially | Potentially | Potentially |

*Data from* Refs.[5,13,19,22,23,27,30,33–37]

pathologic nature of for example, female infanticide.[2,5] Hair-pulling (trichotillomania) and skin-picking (excoriation) behavior are classified as obsessive-compulsive disorders in people[38]; however, in primates, they would have to be scrutinized in regard to species-specific grooming behavior.[28,39] Similarly, aggression must be carefully interpreted in view of the individual's social hierarchical status, social competence and interactions of the other group members, and species-specific social dominance behavior.[37] For example, aggressive behavior of a silverback gorilla toward a female may have to be classified as normal, if the female does not show socially competent, submissive integration into the patriarchic 1-male group structure.[36]

### *Behavioral Analysis*

A structured, comprehensive behavioral analysis and the answering of the question "what is the animal doing when, how often and how much?" is a prerequisite for the therapeutic approach of a potentially abnormal behavior.[40] Consultation with biologists and veterinary behavioral specialists is encouraged to ensure standardized and objectively documented ethological studies. Examples of behavioral profiles in NHPs can be drawn from the literature.[25,39,41] In theory, observations need to encompass 24-hour observations and may have to take seasonality and reproduction into account. Ideally, behavioral observations are performed by remote video recording to exclude the influence of observers. Although resource investment for professional ethological studies can be prohibitive for some institutions, behavioral observations naturally take place during each interaction of daily husbandry by keeping staff. These are self-evident to be included in the behavioral analysis; however, they are particularly vulnerable to preconceptions and bias. Therefore, training of primate caregivers in observation techniques, structured documentation, and sensitizing caregivers about the impact of their own interactions on the behavior are important to attain objectively exploitable information during the daily husbandry routine.[19]

### *Functional Analysis: What Triggers and Maintains the Behavior?*

Most reports of abnormal behavior (see **Box 1**) are mere descriptions of the behavioral patterns. The ABC of Behavior proposes a differentiation of the

Antecedent - the preceding stimulus, event or condition
Behavior - anything the animal does
Consequence - the outcome immediately following the behavior and potentially impacting antecedents via a feedback mechanism[40]

Although behavioral analyses primarily describe the behavior itself, functional analysis serves to identify the triggering and maintaining events and conditions.[19] In this respect, the analysis considers environmental conditions and events, social interactions, and physical health status, including a medical examination to exclude chronic pain, discomfort, or underlying disease (eg, primary neurologic disorders [eg, age-related degenerative diseases], neoplasia or infectious diseases, osteoarthrosis and degenerative joint disease, metabolic disease [eg, diabetes in older primates], or dental disease (**Box 2**).[27,42–46] Special attention is warranted to abiotic factors, predictability of husbandry measures, and possibility of individual control of environmental or social factors.[4] Once identified, testing functional significance of the assumed maintaining/triggering condition in controlling the occurrence of the target behavior by providing and withholding the assumed trigger is necessary to demonstrate the contingent relationship of trigger and behavior.[19]

**Box 2**
**Examples of potential triggers and maintaining factors for abnormal behavior**

- Disease-related: discomfort, pain, disfunction, medical interventions
- Socially related: social/human attention seeking, social separation, social incompatibility/entrapment, change in social structure
- Husbandry-related: translocations/relocation, resocialization; novel objects, change in abiotic environmental factors (eg, light), presence of nearby predators, feeding schedules, restraint practices, recurrent medical interventions, space limitations, suboptimal levels of stimulation, lack of environmental control
- Miscellaneous: anticipation, boredom

*Data from* Refs.[6,14,19,27,30,40,47]

### *Life History*

In order to understand the individual's background, research about its life history is helpful (see **Fig. 1**). In some situations, the past history of an individual may be more predictive of abnormal behavior patterns than its present environmental conditions.[48] Factors such as rearing history, sex, age, reproductive history, social history, and chronic disease processes are important, and should be routinely available from the holding institution's documentation. If that is not the case, a standardized survey may be helpful to gather information from previous holding institutions.

### *Diagnosis of Psychopathology*

The diagnosis of psychopathologies and the use of proper terminology are not part of a standard veterinary training, and most veterinarians will feel at a loss trying to put a name to the clinical picture observed in their patient. For the inexperienced veterinarian, staying at the purely descriptive level of behavioral irregularities may prove far more constructive than attempting to associate the observed behavior with a defined disorder in human medicine (**Box 3**).

However, a thorough comparison of symptoms observed in NHPs with symptoms found in people may help generate testable hypotheses regarding the underlying disturbed psychological mechanisms and identify suitable treatment approaches.[5] For this process, collaboration with a human psychiatrist is encouraged; while veterinarians and/or biologists provide descriptive observations of the behavioral pattern in

**Box 3**
**Selection of terms for the description of abnormal behavior in nonhuman primates**

- Hyperactive, impulsive, irritable, unpredictable, outbursting, aggressive
- Lethargic, withdrawn, indifferent, distrustful, suspicious, depressive
- Anxious, tense, restless, fearful, (selectively) phobic
- Exaggerated startle response, hypervigilant, reckless, self-destructive
- Uncoordinated, clumsy, slow, stereotypic
- Dominant, submissive, impertinent, playful
- Severe, moderate, mild, frequent, occasional, rare

*Data from* American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 5th ed. Washington D.C.: 2013.

regard to species-specific bio-social norms, human psychiatrists can compare these descriptions to defined human psychopathological diagnoses (see Fig. 1). The Diagnostic and Statistical Manual of Mental Disorders (DSM-5)[38] has been used to diagnose human mental disorders; it offers a list of categories of mental disorders and associated symptoms, such as neurodevelopmental, depressive, anxiety, trauma- and stress-related, dissociative, feeding/eating, and impulse-control disorders, all of which have been recognized in NHPs also.[5,6,11,25] Naturally, the description and diagnosis of other disorders like schizophrenia, bipolar disorder, somatic symptom disorder, and personality disorders are also based on verbally reported symptoms and closely linked to human personality traits and cultural norms, and may therefore be less useful in the context of NHP medicine.

## TREATMENT APPROACHES TO ABNORMAL BEHAVIOR

Various therapeutic approaches can be deduced from the counter-clockwise diagnostic procedure proposed by the scheme: environmental/husbandry changes, medical treatment, psychopharmacological treatment, and behavioral therapy (see Fig. 1). All factors of the pathogenesis considered, the combination of several therapeutic options will provide an individually tailored approach.[27,49]

Abnormal behavior itself cannot be treated, but merely managed or prevented. Attempts to treat abnormal behavior must be considered analogous to symptom control in other diseases, without sustainably addressing the underlying disease. In urgent cases, such as automutilation, prevention of further injury or automatically reinforcing consequences may, however, require immediate action and symptom control, such as with special constraints and protective equipment (eg, cast bandages) or negative reinforcing techniques.[19] Treatment goals need to be individually tailored, realistically formulated, and clearly defined in consultation with all stakeholders. Working stepwise toward smaller goals (eg, temporary social integration for a few hours per day, reducing the frequency of abnormal behavior by 50%) may be necessary to appreciate treatment progress and avoid frustrations. Depending on the severity of disease, certain goals may never be attained, and the affected animal may remain susceptible to manifestation of abnormal behavior and require life-long management; for example, social integration and breeding may be attained, but maternal care may never be reached.[18]

### *Environmental/Husbandry Changes and Medical Treatment*

If a functional analysis has identified reinforcing factors, changes in husbandry and management routine, nutrition, social group composition, and medical attention to chronic, painful conditions (eg, dental treatment, analgesia, physiotherapy) may already be efficient to reduce the frequency of abnormal behavior significantly.[19,50] The reader is referred to the large body of literature available on enrichment techniques for NHPs (food-based, sensory, animate and inanimate, cognitive).[21,23,26,51,52] If the enrichment is not carefully chosen to address identified reinforcing factors, the effect will likely prove inconsistent and oftentimes unsustainable in alleviating abnormal behavior.[4]

### *Behavioral Training/Operant Conditioning*

Positive reinforcement training (PRT) can be applied to train and increase affiliative behaviors in asocial animals,[53] and it is generally used to habituate the animal to random medical and husbandry measures to alleviate or avoid associated stressors; yet, it only shows inconsistent success to sustainably treat established

abnormal behaviors.[54–56] Operant conditioning as specific behavioral therapy can only be sustainably effective if 2 principles are respected; the behavioral therapy must address the individual pathogenesis of the abnormal behavior, and it must be aimed at not only reducing the aberrant behavior but simultaneously introducing more desirable, alternative behaviors (differential reinforcement of alternative behavior).[19,50] Specific operant behavioral therapy procedures are used in human medicine and have shown an overall effectiveness of more than 80% reduction in frequency of stereotyped and automutilative behavior.[57] The implementation of these procedures bears great potential in NHPs with abnormal behaviors, but the detailed description of these procedures (eg, non-contingent reinforcement, differential-reinforcement-of-other-behavior, functional communication) goes beyond the scope of this article. The reader is referred to a review article, and cooperation with veterinary behavioral specialists and human psychiatrists for an individually tailored operant conditioning training is encouraged.[19]

### *Pharmacologic Treatment*

If the diagnostic procedure leads to the conclusion of an underlying psychopathological disorder, pharmacologic treatment must be considered, not as a last resort but as valuable flanking measure, as psychopathologically affected patients may not always be able to benefit from behavioral therapy or environmental changes without psychopharmacological support.[5] Sedation is not a target effect but may occur as side effect, and should be avoided or minimized so as to not interfere with social interactions and the learning process from operant conditioning. Therefore, the commonly used benzodiazepines are not recommended as a first-line choice. Although they may be helpful to control acute episodes of abnormal behavior, particularly with imminent risk of harm, inconsistent and unsustainable long-term effects are likely, because the sole GABAergic effect of benzodiazepines fails to address the complex neuroendocrine imbalances of most psychopathologies.[58]

The major categories of drugs used for pharmacologic interventions in psychopathologies target the opiate (eg, opiate antagonists), serotonergic (eg, selective serotonin reuptake inhibitors [SSRIs]), dual-serotonin-norepinephrine uptake inhibitors (SNRIs), serotonin-receptor agonists or antagonists (MAO-A inhibitors, tryptophan supplements), and dopaminergic (eg, dopamine receptor blocker) systems.[11] Consultation with a veterinary behavioral specialists or human psychiatrists is recommended to appropriately attune the drug therapy to specific features of the psychopathological disease (eg, hyperactivity, anxiety, or motor stereotypy) and to control potential undesirable effects. Whereas most reports of psychopharmacological drug use in NHPs originate from experimental research with NHPs as models for human psychopathologies,[11,27,59–69] reports about the use and effect of psychopharmacological drugs in captive NHPs in zoologic institutions are rare.[49,70,71]

### *Genetic Selection*

Given the genetic influence on personality traits and susceptibility to psychopathological disorders, genetic selection may offer a viable strategy, as it has been successfully used to reduce stereotypic behavior in poultry and farmed minks.[48] This approach is currently not of major relevance to zoos but the inclusion of not only physical but also mental health may have to be increasingly included as a criterion for captive breeding programs (**Box 4**).

**Box 4**
**Case report**

### The patient, life history, and behavior

Western lowland gorilla (*Gorilla gorilla gorilla*), female, 39 years, nulliparous, living in a group of 3 adult females and one silverback gorilla in a zoologic institution in Western Europe.

The animal was born in captivity and handraised for unknown reasons. At the age of 2 years, she was placed in a family group at another zoologic institution, but resocialization failed, whereupon she was sent back to the institution of origin. At the age of 3 years, another attempt failed to introduce her to a family group in a zoologic institution, whereupon she was sent on to her final destination, where she was tolerated into a group of 3 other handraised females and 1 silverback but remained the lowest-ranking member of the group.

According to anecdotal reports, the animal started showing automutilation of hands and feet at the age of 5 years, prompting several invasive, surgical, and preventative (cast bandages) measures and various medical treatments, including administration of alcoholic beverages for tranquilization. Detailed medical history started at the age of 24 years, documenting at least 3 severe episodes of self-injurious mutilation to hand and feet within the following 15 years, crippling her right foot and hand significantly. During this time, the animal underwent approximately 88 documented anesthestic procedures for surgical and medical wound treatments, bandage changes, and diagnostic procedures (general health examinations, imaging diagnostics, and virologic and bacteriologic screenings), went through many months of social isolation for treatments, countless drug treatments (analgesics, antibiotics, psychopharmacological treatment, homeopathy, and nutritional supplementations) and was exposed to a myriad of enrichment procedures. None of the diagnostic screenings provided any coherent evidence for etiology, nor were any of the treatment approaches sustainably effective. Therefore, interdisciplinary consultation with veterinarians, human psychiatrists, and biologists was chosen for a comprehensive approach.

### Diagnostic procedure and results

1. Behavioral analysis: the self-injurious behavior as described was considered abnormal because of significant physical harm.
2. Functional analysis: remote video recording revealed purposeful display of automutilative behavior in presence of keeping staff, in order to attract attention from keepers, particularly during cleaning routine, when interaction with the animals was limited. Medical examination revealed a chronic subluxation of the right elbow and coxarthrosis.
3. Life history: early maternal separation, handraising, and several placements in 3 social groups were likely to result in altered development and dysregulation of the neuroendocrine system.
4. Diagnosis of psychopathology:
   a. Descriptive terminology: little patience, low frustration threshold, sudden mood changes, irritable, aggressive bouts against keepers, anxiety
   b. Suspect diagnosis by human psychiatrist: borderline-like syndrome

### Therapeutic approaches:

1. Withdrawal of attention in regard to self-injurious behavior: keepers were instructed to strictly ignore any self-injurious behavior. In fact, during separation of the animals in the background of the exhibit during cleaning routine, keepers had to first observe the animals on a remote video screen before approaching their enclosures. If any self-injurious behavior or even intentions for such were evident, keepers had to turn away and leave the animals alone.
2. Operant conditioning: several elements of training were introduced as targets for keepers' attention. Because of the impatient and irritable personality of the animal, training goals

had to be carefully chosen not to elicit any frustrations, such as assuming positions for physical examination or trading of objects.

3. Physiotherapy and analgesia: chronic pain was addressed by long-term analgesia (primarily nonsteroidal anti-inflammatory drugs), and part of the training elements consisted of physiotherapeutic exercises, such as reaching for targets out of immediate reach, prompting the animal to stretch and mobilize her disabled elbow and stiff joints.
4. Psychopharmacological drugs: not considered necessary in this case.

**Outcome**

Only a few months after implementation of strict disregard of the self-injurious behavior and training of alternative behaviors to seek attention, the previously chronic wounds on hand and feet healed up without medical treatment. About a year later, inadvertent testing of the hypothesis of human attention as maintaining factor happened when a new keeper, who had missed respective instructions regarding the interaction with this animal, triggered a new episode of self-injurious wound manipulations by paying attention and reporting small skin wounds well-meaningly. Correction of the keeper's behavior resulted in wound healing within a few weeks.

## DISCLOSURE

The author has nothing to disclose.

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